Comment on "Chiral symmetry and the intrinsic structure of the nucleon"- by D.B.Leinweber,A.W Thomas and R.D.Young.

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The authors of ref.[1], using QCD plus approximate chiral symmetry show that the "perfect" prediction 3/2 for $|\mu(p)/\mu(n)|$ is coincidental. I agree; infact this was discussed in [2b,3,5] on the basis of the general QCD parameterization (GP). The argument in [2,3] is more general than that in [1], but [1] is of interest, because it exemplifies an explicit mechanism that may produce the coincidence. Yet I disagree with a statement in [1]. It is: "Within the constituent quark model this ratio would remain constant at 3/2, independent of the change of the quark mass". This is so for an additive [4], but not for a general constituent model.

For the lowest hadronic multiplets the GP relates [2,3] all possible constituent models to QCD. It parametrizes in the most general way compatible with QCD the properties (masses, magnetic moments, etc.) of the lowest hadron multiplets. It was started [2a] to explain the fair quantitative success of the simple non relativistic model [4]. Although non covariant (we work in a given frame), the GP is relativistic, based only on general properties of relativistic QCD. Also [3] the renormalization point for quark masses can be selected at will in the QCD Lagrangian; i.e. the GP is compatible [3] with a quasi-chiral description, with light u,d quarks.(The script symbols for quark fields that I used in [2] may be confusing on this; they seem to imply $\approx$ "300" MeV masses for u,d quarks in the QCD Lagrangian. Standard symbols u,d,s were used from [3] on.)

For each quantity considered, the GP gives the most general spin flavor parameterization compatible with QCD. This alone is not much. Indeed e.g. for the **8**

plus **10** baryon masses, the GP has 8 parameters to fit 8 masses. Clearly trivial! But, fitting the data, a hierarchy in the parameters emerges: The parameters multiplying spin-flavor structures of increasing complexity are smaller and smaller. This is true for any quantity treated so far, in particular the baryon magnetic moments. The reduction factor due to increasing complexity of GP terms is, from the data, the product of $\cong 0.3$ for each flavor breaking factor (FB) and 0.2-0.37 for each pair of different indices in the term ("gluon exchange" factor [2b]). In [2,3] we parametrized the magnetic moments of the octet baryons up to first order in FB. There are seven data and seven parameters, called g_i The g_i's are functions of the quark masses and Λ_{QCD}. To first order FB the expression so obtained is the most general one in QCD or in any constituent quark model compatible with it. It was underlined in [2b,3,5] that all g_i's agree, to a factor 2, with the expectations from the hierarchy taking a gluon exchange factor from 0.2 to 0.35; only g_3 is ≈ 7 (or 10) times smaller (g_3 is,in the GP, the coefficient of the term giving the deviation of $|\mu(p)/\mu(n)|$ from 3/2. In [(2b), Eq.(23)] such factor 7 (or 10) was possibly attributed to chance.

This conclusion on chance is much reinforced (Sect.4 of [5]) considering only the parametrized μ's of the non strange baryons of **8+10** (p,n,Δ's). Then we have four parameters $(\alpha, \beta, \gamma, \delta)$. The "perfect" 3/2 arises from $g_3 = \delta - \beta - 4\gamma \cong 0$. That this particular combination almost vanishes can be due only to a chance cancellation; a cancellation compatible with the typical hierarchy reduction, and with the known $\mu(p)$,$\mu(n)$ and $\mu(\Delta \to p\gamma)$. A measurement of $\mu(\Delta^+)$'s would allow a further check.

References

[1] D.B.Leinweber, A.W.Thomas, R.D Young, Phys.Rev.Lett.**86**, 5011 (2001)

[2] G.Morpurgo, a)Phys. Rev. D **40**, 2997 (1989), b)Phys. Rev. D **46**, 4068 (1992)

[3] G.Dillon and G.Morpurgo, Phys. Rev. D **53** 3754 (1996) and references therein; a fairly complete set of references is found in G. Dillon and G.Morpurgo, Europhys.Lett. **54**, 35 (2001)

[4] G.Morpurgo, Physics 2, 95 (1965) [reprinted in Kokkedee J.J.J.,*The quark model*, Benjamin, New York, 1969-p.132]; also G.Morpurgo, in *Proc.of the XIV Int. Conf. on High Energy Physics*, Vienna, 1968 ed. by J.Prentki and J.Steinberger (CERN, Sci.Info.Service, Geneva, 1968, p 223-249.)

[5] See Sect.4 of G.Dillon and G.Morpurgo, ArXiv:hep-ph/0011202 and the ref.[17] there.